



# **11th Annual Student Center for Science Engagement Research Symposium**

*In Partnership with NIH MARC U-STAR*

**September 27, 2019**

**NEIU El Centro Campus**

**8:30 AM to 4:00 PM**

3390 N. Avondale Ave, Chicago, Illinois 60618



# **The Student Center for Science Engagement Eleventh Annual Research Symposium**

Friday, September 27, 2019  
Northeastern Illinois University  
El Centro Campus  
Chicago, Illinois

## **Student Center for Science Engagement**

Sudha Srinivas, Ph.D., Associate Dean  
College of Arts and Sciences

Kenneth Voglesonger, Ph.D., SCSE Director  
Professor, Earth Science

Rey Ayon, Academic Success STEM Coach

Shreya Patel, Ph.D., Physical Sciences Advisor

Laura West, Student Academic Services  
Specialist in STEM

Cynthia Roth-Garfield, Office Manager

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Associate Professor, Mathematics

Elisabet Head, Ph.D. Associate Professor,  
Department Coordinator of Earth Science

Rachel Trana, Ph.D. Assistant Professor,  
Computer Science

Jennifer Slate, Ph.D. Professor,  
Biology

# Eleventh Annual Student Center for Science Engagement Research Symposium

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## **Student Center for Science Engagement (SCSE)**

### **MISSION AND GOALS**

The mission of the SCSE is to significantly improve recruitment, retention and graduation rates for students in STEM disciplines, with an emphasis on minority, low-income, and first generation students. The goals of the SCSE are being achieved by enhancing academic support and mentoring through advising, faculty-student research projects, and peer mentoring. We provide professional development opportunities to students through internships, networking opportunities, connections with leaders in STEM industries and academic institutions. We also foster career exploration in STEM fields and the development of programming focused on reaching minority, low-income and first generation students. The SCSE is proud to serve NEIU and support future student success in the sciences.

# Eleventh Annual Student Center for Science Engagement Research Symposium

## Message from the College of Arts and Sciences

It gives me great pleasure to welcome you to the 11th Annual SCSE Research Symposium. In just over a decade, undergraduate summer research in the sciences at Northeastern Illinois University has grown from a few groups of students working with faculty mentors within their departments, to a robust, structured summer research program with dozens of students working with faculty across the STEM disciplines at NEIU. The presentations at the symposium today will give you all an appreciation of the breadth and depth of the scientific questions that our students have been investigating all summer.

To our students presenting their work today, congratulations! You have learned a lot through this experience, and I hope you have also appreciated the joys that come from diving deep into a topic and studying it all summer. I ask that you view your presentations at this symposium not as a culmination of your summer research, but as a step in the process of becoming engaged scientists and researchers. As you enjoy the presentations today, do take a moment to appreciate the faculty mentors who have guided you along on this scientific journey and your fellow students that have travelled along with you.

Again, congratulations to the students on your work, and thank you to the faculty mentors and the SCSE staff for your deep commitment to summer research at NEIU!

Sudha Srinivas  
Professor of Physics and Acting Associate Dean  
College of Arts and Sciences

# Eleventh Annual Student Center for Science Engagement Research Symposium

## SCSE Director's Message

Welcome everyone to the 11<sup>th</sup> Annual Research Symposium of the Student Center for Science Engagement (SCSE), co-sponsored with the NIH MARC NU-STAR Program! All of us in the SCSE are excited about the research and collaborations that were part of the summer program, both at NEIU and at other institutions. The SCSE Summer Research Program has continued to flourish, with 51 students and 22 faculty involved in 18 different research groups. These projects represented all of the STEM disciplines, with many interdisciplinary collaborations. These partnerships extended outside of the NEIU campus with students working with the scientists at the Field Museum, Northwestern University, The Lincoln Park Zoo, Ithaca College, and the Illinois Institute of Technology. Whether projects were done at NEIU or elsewhere, they are only possible with the support and efforts of faculty mentors that work together with students to form strong and authentic research communities. Vital support also came from the College of Arts and Sciences, Academic Affairs, and the SCSE Executive Board. This year I specifically want to recognize the U.S. Department of Education Hispanic Serving Institutions Title III program, which funded the majority of research projects and activities this summer. It is also important to recognize the work of the SCSE staff in supporting all of the work that went into supporting students and faculty, as well as their dedication in organizing and coordinating this Symposium. I want to express sincere thanks on behalf of the SCSE to the El Centro Campus community for all of their support and for hosting us again this year.

Finally, I want to emphasize not just the excellent work that was done over the summer, but also the building of a culture and community at NEIU that values and emphasizes these research experiences for our students, faculty, and staff. This is the result of all those involved, especially the talents, abilities, dedication, enthusiasm, and determination of our students.

Congratulations to everyone! I hope that you all enjoy the day!

Ken Voglesonger,  
Director, Student Center for Science Engagement and Associate Professor of Earth Science  
College of Arts and Sciences

# Eleventh Annual Student Center for Science Engagement Research Symposium

## KEYNOTE SPEAKER BIOGRAPHICAL SKETCH

**Dr. Julie Libarkin**

"Drawing On Science"

Professor of Environmental Science,  
Michigan State University

**\* Keynote speaker was sponsored by the NIH Maximizing Access to Research Careers (MARC) U-STAR Program**



Julie is a Professor of Environmental Science at Michigan State University where she runs the Geocognition Research Lab leading investigations of how people perceive, understand, and make decisions about the planet and human impacts. Dr. Libarkin began her career studying geology and physics at the College of William and Mary, and received a PhD in geosciences from the University of Arizona.

Upon graduation, she immediately began a National Science Foundation Postdoctoral Fellowship in Science, Mathematics, Engineering, and Technology Education. She worked in the Science Education Department at the Harvard-Smithsonian Center for Astrophysics, served for a short time as a research scientist at the Center, and taught for three years as an Assistant Professor at Ohio University before her move to Michigan State. Currently, her research focuses on model-driven research design, community-engaged research, and mentoring to address access, inclusion, equity, and justice in STEM and academia.

\* The National Institutes of Health MARC U-STAR (Maximizing Access to Research Careers Undergraduate Student Training in Academic Research) Program at Northeastern Illinois University is a comprehensive educational program for college juniors and seniors. It comprises innovative curriculum developments that integrate quantitative sciences into the program of study of the STEM disciplines, diverse research experiences that include summer research training in research-intensive universities, and structured mentoring and advising. In addition, the MARC Program provides a stipend for two years and covers 60-100% of tuition. **Applications to accept 4 students will open at the beginning of Spring 2020 semester. For more information, please visit MARC website: [cs.neiu.edu/marc](https://cs.neiu.edu/marc)**



# **Eleventh Annual Student Center for Science Engagement Research Symposium**

## **SYMPOSIUM SCHEDULE**

8:30-9:00 A.M.

Breakfast and Registration (1<sup>st</sup> Floor Lobby)

9:00-9:15 A.M.

Welcome and Opening Remarks (1<sup>st</sup> Floor Lobby)

9:15 A.M.-10:15 A.M.

Keynote Speaker (1<sup>st</sup> Floor Lobby)

11:00-12:30 P.M.

Podium Presentations (Rooms 201 & 320)

12:30 P.M.-1:00 P.M.

Lunch Break (1<sup>st</sup> Floor Lobby)

1:00-2:00 P.M.

MARC NU-STAR & SCSE Awards (1<sup>st</sup> Floor Lobby)

2:00-4:00 P.M.

Poster Presentations (3rd Floor, Rooms 308, 312, 327, & 332)

# ABSTRACTS OF PODIUM PRESENTATIONS

## SYNERGY OF ESSENTIAL OILS WITH ANTIBIOTICS AGAINST MULTIDRUG RESISTANT *PSEUDOMONAS AERUGINOSA*

Alexis L. Hamm and Emily Booms, Ph.D.

Department of Biology, Northeastern Illinois University, Chicago, IL 60625

The World Health Organization estimates that by the year 2050, multidrug resistant (MDR) infections will affect 9 million people per year globally. This highlights the importance of identifying additional treatment sources outside of antibiotic therapies alone to overcome MDR infections. Multidrug resistant bacteria of the ESKAPE group of pathogens, such as *Pseudomonas aeruginosa*, are responsible for the sharp rise in untreatable bacterial infections. *P. aeruginosa* is a gram-negative bacterium that has known MDR strains. It is a nosocomial pathogen that causes a diverse range of infections. Our study explores the ability of essential oils to synergize, or enhance, the efficacy of antibiotics to inhibit MDR *P. aeruginosa* infection. We have previously identified 11 essential oils that have strong inhibitory activity against the *P. aeruginosa* MDR strain, ATCC BAA 2110. We also confirmed that the MDR strain used was resistant to four antibiotics, intermediate to two other antibiotics, and susceptible to three additional antibiotics. Initial synergy testing was performed in triplicate at 20% oil concentration using a modified disc diffusion assay method. We tested 11 essential oils with nine antibiotics against ATCC BAA 2110 strain. Our initial findings suggest that, of the essential oils tested, the following combinations of essential oils synergize with antibiotic treatment against ATCC BAA 2110 strain: cinnamon branch/gentamicin, mugwort/cefotaxime, mugwort/tetracycline, oregano wild/cefotaxime. We are conducting an additional trial to confirm our findings and we are also analyzing our data using ImageJ software to establish a method to quantify synergy using.

## GENDER DIFFERENCES IN THE STABILITY OF LOGIN TIMES AND ACADEMIC PERFORMANCE

Annick Laure Ishami<sup>1</sup>, Michael Vujnovich<sup>1</sup>, Benjamin L. Smarr, Ph.D.<sup>2</sup>, and Aaron E. Schirmer, Ph.D.<sup>1</sup>

<sup>1</sup> Department of Psychology, University of Berkeley, California USA, 94720

<sup>2</sup> Department of Biology, Northeastern Illinois University, Chicago USA, 60625

Circadian rhythms are biological processes that show 24-hour oscillations that are synchronized with the environment. Social jetlag (SJL) arises when our internal circadian rhythms are misaligned with the environment due to social impositions such as work or school. Previous data have shown that there is a negative correlation between SJL and academic performance, but data on how gender influences SJL and academic performance are limited. To explore these interactions we utilized login data from over 14,000 students from the Northeastern Illinois University learning management system Desire 2learn (D2L). Interactions between SJL and academic performance (GPA) were explored between genders using the R 3.5.0 statistical package. Preliminary results showed that female students have higher GPAs than male students on average, but have similar SJL levels as male students. Further analyses revealed that females' login activity was less variable than males across the semester in both fall and spring and lower variability was correlated with an increase in academic performance.

Interestingly, this same pattern was found looking at the change in variability from one semester to the next: students who showed consistency in their login patterns performed better than less consistent students. Understanding these interactions will help to consider both genders as research models given the gender bias saying that males are more stable than females. It will also help individuals more effectively schedule their time to minimize their login variability, hence maximize academic performance.

## **MOLECULAR TOOL MAY HELP WITH EARLY DETECTION OF INVASIVE PLANT SPECIES: A CASE STUDY WITH *TYPHA DOMINGENSIS***

Samantha García<sup>1</sup>, Gloria Ríos<sup>2</sup>, and Pamela Geddes, Ph.D.<sup>1,2</sup>

<sup>1</sup>Environmental Science Program, Northeastern Illinois University, Chicago, Illinois, 60625

<sup>2</sup>Department of Biology, Northeastern Illinois University, Chicago, Illinois, 60625

There are three common *Typha* species (cattails) in the Midwestern U.S.: native *Typha latifolia*, invasive *Typha angustifolia*, and an aggressive hybrid between the two, *Typha x glauca*. First-time sightings of southern cattail, *T. domingensis*, were reported in Wisconsin and Ohio, beyond its native range. This northward expansion may promote hybridization between *T. domingensis* and the Midwestern species creating new aggressive hybrids that decrease native plant biodiversity as has been documented for *Typha x glauca*. Additionally, these four *Typha* species are morphologically similar, making it difficult to identify them visually. Recent studies suggest molecular analysis can accurately identify *Typha* species. Therefore, we hypothesized that molecular markers (microsatellites) would provide a genetic signature unique to *T. domingensis* allowing its differentiation from the Midwestern cattails. We genetically tested 11 *T. domingensis* samples collected from its native range in Florida using 6 microsatellite markers that are diagnostic for the Midwestern cattails. Results from those markers were inconclusive; therefore, 29 previously-developed markers from *T. angustifolia*, *T. latifolia*, and *T. minima* were tested on the FL samples. We found 10 markers (4 from *T. angustifolia*, 2 from *T. latifolia*, and 4 from *T. minima*) to be reliable indicators of *T. domingensis* for the FL samples. Finding a genetic signature unique to *T. domingensis* is a priority so that we can continue to monitor its invasion and possible hybridization by testing these eight diagnostic markers against the presumable *T. domingensis* samples found in Middleton, WI, allowing us to act before areas become dominated by it.

## **METAL ENVIRONMENTAL CONTAMINANT ANALYSIS VIA CARBON NANODOT EXTRACTION**

Allisia Dawkins, Rameen Karar, Cinthya Osuna, and Stefan Tsonchev, Ph.D.

Department of Chemistry, Northeastern Illinois University, Chicago, Illinois, 60625

Carbon Nanodots (CNDs) are nanometer sized particles that are low in toxicity, low in production cost, possess intense fluorescence over the visible range, and have a multitude of potential chemical and biological applications. The surface of the carbon nanodots has many different functional groups, making it modifiable with organic, inorganic, or polymeric substances, thus allowing for a variety of functional properties. Syntheses and standardization of three variations of CNDs: blue-sulfur based, blue-nitrogen based, and orange carbon based nanodots were produced via the bottom up route by using small saccharide-based molecules, such as fructose,

with either sulfuric acid or urea and an external energy source such as a hot plate or microwave to produce black charcoal. Metal salts representative of environmental contaminants are combined with the three types of CNDs to investigate the possible contaminants' detection. The goal of the research is to observe any potential changes in the suspension of the CNDs by using spectroscopy to determine which CNDs can act as potential metal detectors for aqueous contaminants in the environment.

## **SPIRAL WAVE PATTERNS IN TWO SPECIES PREDATOR-PREY MODEL**

Erica Albrigo and Paulo Acioli, Ph.D.

Department of Physics, Northeastern Illinois University, Chicago, IL 60625

Computational methods can be used to model a wide variety of phenomena in the natural world. Work that illustrates interesting natural phenomena has particular value, for its ability to generate interest in critical environmental issues. This work focuses on modeling interaction between two and three species, and how their interrelated populations contribute to spatial patterns and persistence. While much of the current literature focuses on continuous modeling, we pursue a discrete method, which we believe illustrates more realistic circumstances, and offers greater control of system conditions. This research establishes a method to model predator-prey interactions and identify resultant spatial patterns. The discrete model is able to illustrate multiple species interactions and is designed to be easily expanded to include any number of prey, predator, or vegetation species. The relationships can be modified parametrically, offering control of the dependencies between species, the growth rate of vegetation, and probabilistic birth and death rates. We examine patterns that are formed as a function of population movement over time, as well as what parameters promote species persistence. We show that spiral waves will form when conditions are less favorable for prey animals, such as when predators work cooperatively, or when the death rate is high. Similarly, spiral patterns are found when vegetation growth rate is slowed, or prey's consumption rate is high. Moving forward, we expect to expand the number of species modeled, as well as conduct a more thorough comparison of the strengths of this discrete model as compared to the continuous model.

# THE ROLE OF WERNER PROTEIN IN RESPONDING TO OXIDATIVE STRESS IN *DROSOPHILA MELANOGASTER*

Derek Epiney and Elyse Bolterstein, Ph.D.

Department of Biology, Northeastern Illinois University, Chicago, Illinois 60625

Oxidative stress, the toxic buildup of free radicals, causes DNA damage and interferes with DNA replication. The RecQ helicase protein, WRN, responds to DNA damage and is involved in maintaining genomic stability. Mutations in *WRN* cause Werner syndrome, a disease characterized by accelerated aging and an increased risk of cancer. In *Drosophila melanogaster*, the WRN ortholog, WRNexo, only has a conserved exonuclease domain allowing us to separate its exonuclease function from the helicase. A deletion in *WRNexo* (*WRNexo*<sup>Δ</sup>) results in deficiencies in DNA replication during the embryo and larval life stages. We investigated if *WRNexo* protects against DNA damage caused by oxidative stress during development by treating *WRNexo*<sup>Δ</sup> larvae with paraquat, an herbicide that generates free radicals. Surprisingly, *WRNexo*<sup>Δ</sup> larvae are not sensitive to paraquat. Oxidative stress can also cause lipid peroxidation, leading to membrane damage and decreased body fat. Using larval buoyancy as a measure of body fat, we observed lower body fat in *WRNexo*<sup>Δ</sup> compared to wild type flies, which was partially rescued by feeding larvae antioxidants. We found that *WRNexo*<sup>Δ</sup> adults are sensitive to ethanol, another source of free radicals, but this sensitivity can be partially rescued by vitamin E treatment. Together our results suggest that *WRNexo* is involved in responding to oxidative stress but is not the primary mechanism in protecting against oxidative stress-induced damage. Understanding the interactions of WRNexo in responding to oxidative stress may allow us to develop better chemotherapy drugs and provide further insight on cancer and aging.

## THE ROLE OF SEM-5/Grb2 RECRUITMENT IN FGF RECEPTOR TYROSINE KINASE SIGNALING IN *C. ELEGANS*

Jessica Palalay<sup>1</sup>, Jason E. Webb<sup>2</sup>, Carolina Gaudenzi<sup>2</sup>, Cindy Voisine, Ph.D.<sup>1</sup>, Te-Wen Lo, Ph.D.<sup>2</sup>, and Michael Stern, Ph.D.<sup>1</sup>

<sup>1</sup>Department of Biology, Northeastern Illinois University, Chicago, IL, 60625

<sup>2</sup>Department of Biology, Ithaca College, Ithaca, NY, 14850

Fibroblast growth factor receptors (FGFRs) belong to a family of receptor tyrosine-kinase (RTK) cell-surface receptors, which phosphorylate specific tyrosine residues to trigger fundamental biological downstream responses. The sole FGFR in *Caenorhabditis elegans*, EGL-15, is involved in multiple functions, including serving as a receptor for a chemoattractive guidance cue for the migrating sex myoblasts (SMs), ensuring the egg-laying muscles are in functional positions. EGL-15 also regulates internal fluid levels; hyperactivation of EGL-15 causes excessive accumulation of clear fluid inside the worm's body cavity, resulting in a Clear (Clr) phenotype. The isolation of mutations that suppress the Clr phenotype has led to the identification of many core components of the EGL-15 signaling pathway. For example, the original set of suppressor mutations identified the Grb2/SEM-5 adaptor protein that links RTK activation to the activation of the RAS/MAPK pathway. SEM-5 participates in both functions of EGL-15, in part by binding two YXNX motifs in the carboxy-terminal domain (CTD) of EGL-15 in a phosphorylation-dependent manner. An *egl-15* nonsense mutation, *n1457*, that truncates

EGL-15's CTD strongly affects SM chemoattraction, and has subliminal effects on fluid homeostasis. To determine whether the role of the CTD is due to the recruitment of SEM-5 at these two binding sites, tyrosines Y1009 and Y1087 were mutated to phenylalanines to block phosphorylation and binding. In comparison to the *n1457* mutation, the double mutant strain, *syb850 syb821*, shows similar, but weaker phenotypes. These results demonstrate that the two tyrosine binding sites are the predominant mechanism coupling SEM-5 to EGL-15.

## **THE INHIBITORY EFFECTS OF SOIL BACTERIA ON *BATRACHOCHYTRIUM DENDROBATIDIS***

Emily T. Yalda, Jason M. Block, and Emily A. Booms, Ph.D.

Department of Biology, Northeastern Illinois University, Chicago, Illinois 60625

Chytridiomycosis is an infectious disease in amphibians caused by the parasitic fungus *Batrachochytrium dendrobatidis* (Bd). During Bd reproduction, zoospores are released from mature zoosporangia, which thicken outer epithelial layers, preventing gas exchange and leading to amphibian death. Data from 2010 shows that Illinois amphibians may be at risk for chytridiomycosis as the percent of amphibians carrying Bd is surprisingly high. Research from 2018 reveals that while Bd persists, surviving amphibian populations are less susceptible, allowing them to resist the effects of Bd. We aim to identify what factors contribute to this Midwest resistance. Literature suggests soil composition in the surrounding ecosystem may inhibit Bd survival. In our study, we collected soil from an aquatic Chicago location, isolated bacteria, and exposed a lawn of Bd to discs soaked in soil bacteria-conditioned media to assess inhibitory zones. We hypothesize that over time, zoospore survival will decrease, having been inhibited by antifungal peptides or compounds secreted by soil bacteria. In our preliminary assessment, bacterial species #2 displayed a measurable zone of inhibition compared to other species tested. Next we exposed Bd zoospores to bacteria-conditioned media, and counted live versus dead zoospores using Trypan blue under a hemocytometer three, six, and nine-days post-exposure. Species #2 decreased Bd growth nine days post-exposure by 61% compared to mock-treated zoospores. The data suggests that soil-dwelling bacteria species #2 could be protecting Midwest amphibians from Bd. Next, bacteria species #2 will be identified with analysis of the bacteria-conditioned media to identify what substance(s) is/are responsible for Bd inhibition.

## **GENERATING AN FFAR3 KNOCK-IN MOUSE TO STUDY MICROBIOME-HOST COMMUNICATION**

Sergio Escobar<sup>1</sup>, Tyler Cook, Ph.D.<sup>2</sup>, and Virginie Mansuy-Aubert, Ph.D.<sup>2</sup>

<sup>1</sup>Department of Chemistry, Northeastern Illinois University, Chicago, Illinois 60625,

<sup>2</sup>Department of Cell and Molecular Physiology, Loyola University Chicago, Maywood, IL 60153

The gut microbiome plays a key role, influencing the endocrine, immune, and peripheral nervous systems, and presents a broad and important avenue of research, especially in light of the current obesity epidemic. The gut microbiome's metabolites, known as short chain fatty acids, are pivotal in metabolism and gut to brain communication. Short chain fatty acids are believed to interact with a G coupled protein receptor called FFAR3. This receptor is believed to be the key in understanding the interactions between the gut microbiome and brain and the potential treatment of obesity. However, this interaction is poorly understood due to lack of suitable investigation tools. The aim of this project is to develop a mouse that will have a "Cre recombinase" gene attached to FFAR3 positive cells via CRISPR-Cas9, allowing for a broader understanding of this receptor to be gleaned.

This mouse model will aid gene study by making it possible to use tissue specific knockouts, among other methods. A large portion of the research has consisted in developing the tools needed to perform the CRISPR-Cas9 and optimizing them. Three overlapping fragments were created containing the Cre recombinase gene and were introduced into genomic FFAR3 DNA using an infusion kit. The resulting plasmid was tested using gel electrophoresis as a preliminary check, and has been verified to contain all three desired fragments. In the following months, sequencing will be performed in a core facility. Once their identity has been fully confirmed, embryo fertilization will begin.

# ABSTRACTS OF POSTER PRESENTATIONS

## 1. INHIBITORY EFFECT OF 6-SHOGAOL ON GROWTH OF TUMOR CELL LINES

Robynne S. Alegado, Astrid Vargas, and Sue Mungre, Ph.D.  
Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Cancer remains a leading cause of death in the United States. Although chemotherapy and radiation therapy are being currently used to treat cancer, they have from detrimental side effects. Hence, several studies are focused on natural herbs and compounds as an alternate therapy. We studied the effect of ginger compounds on two tumor cell lines. *Zingiber officinale*, commonly known as ginger, is a natural dietary root that has been used for centuries in food and in medicine due to its anti-diabetic, anti-inflammatory anti-apoptotic, and anti-carcinogenic properties. Two of ginger's major active compounds, 6-gingerol and 6-shogaol, show protective effect against diabetes, cardiac and hepatic disorders. We tested the effect of these compounds on tumor cell lines, HeLa (epithelial tumor cells) and PC12 (adrenal tumor cells). Both cell lines were treated with varying concentrations of the compounds for 24 hours. Cell viability was measured using colorimetric mitochondrial enzyme assay. 50  $\mu$ M 6-shogaol caused 65% cell death in HeLa and PC12 cells. However, 6-Gingerol did not show much effect on either cell line. Maximum effect of 6-shogaol was obtained at 200 $\mu$ M in HeLa cells and 50 $\mu$ M in PC12 cells. Our studies show that micromolar concentration of naturally occurring 6-shogaol inhibits the growth of tumor cells. We will further study the optimal time of treatment and the signaling pathway involved in the effect of 6-shogaol on both cell lines.

## 2. EVALUATING THE AGGREGATION PROPENSITY OF TDP-43 USING *CAENORHABDITIS ELEGANS*

Yaseen Ali, Yuriy Khlopa, and Cindy Voisine Ph.D.  
Department of Biology, Northeastern Illinois University, Chicago, Illinois 60625

Amyotrophic Lateral Sclerosis (ALS) is an age-related neurodegenerative disease that leads to the loss of motor neuron function. Previous research has linked mutations in the gene encoding TAR DNA-binding protein (TDP-43) to familial forms of ALS. TDP-43 is an essential protein involved in RNA processing and is found in cytosolic aggregates in diseased neurons. Our research intends to understand the link between TDP-43 aggregate propensity and neurotoxicity in ALS patients using the nematode *Caenorhabditis elegans*. For our studies, we are taking advantage of the short life cycle and transparency of *C. elegans*. We generated *C. elegans* transgenic lines expressing either wild type or mutated TDP-43 fused to a yellow fluorescent protein (YFP). The change in aggregation patterns will be compared between these strains. To monitor these changes, age synchronized animals are grown in liquid culture and protein lysates are prepared for young and aged animals. Centrifugation followed by western analysis will be used to evaluate aggregate formation. I hypothesize that mutated TDP-43 will be more aggregated than wild type, consistent with previous reports. Furthermore, we hypothesize that TDP-43 aggregation will increase in both strains as animals age. Our goal is to understand how mutations in TDP-43 are linked to neurodegeneration in ALS.



### 3. CHARACTERIZING THE ROLE OF TDP1 DURING DEVELOPMENT IN *DROSOPHILA MELANOGASTER*

Vada Becker, Deborah Onofrei, and Elyse Bolterstein, Ph.D.

Department of Biology, Northeastern Illinois University, Chicago, Illinois 60625

Oxidative stress is the overaccumulation of free radicals produced by exogenous and endogenous toxins that results in extensive DNA damage. One such form of DNA damage is the accumulation of DNA-protein crosslinks (DPCs), which are removed by tyrosyl-DNA phosphodiesterase (TDP1). In humans, TDP1 mutations lead to spinocerebellar ataxia with axonal neuropathy (SCAN1), in which patients suffer from reduced sensation and motor abilities. We used *Drosophila melanogaster* mutated in the homologous gene, *glait* (*gkt*<sup>c03958</sup>), to understand how TDP1 responds to DNA damage caused by oxidative stress. We confirmed that *gkt*<sup>c03958</sup> larvae are sensitive to topoisomerase-inhibitors through observing increased death and rough eye phenotypes in response to camptothecin, indicating significant cellular damage during development. *gkt*<sup>c03958</sup> larvae were not sensitive to paraquat, an herbicide that induces oxidative stress, suggesting *glait* is not majorly involved in repairing oxidative damage at the larval stage. *Glait* is highly expressed in the embryonic stage of fly development and the gonads of adults. We sought to determine if *glait* is involved in fertility and eggs laid by *gkt*<sup>c03958</sup> females show significantly lower hatching frequency. Decreased hatching is potentially caused by defects in syncytial nuclear division due to an accumulation of DPCs during embryogenesis. We assessed *glait* involvement in development by conducting lifespan assays and motility assays. Preliminary data suggest that *gkt*<sup>c03958</sup> males have a shortened lifespan and decreased motility compared to wild type flies. Characterizing *glait* will contribute to our understanding of the mechanisms involved in the degenerative phenotypes exhibited by SCAN1 patients, potentially leading to better treatments.

### 4. WHAT MOVIE SHOULD I WATCH? USING A COLLABORATIVE FILTERING SYSTEM TO PREDICT USER PREFERENCES

Jonathan Carr, Sana Kanwal, Xiwei Wang, Ph.D., and Marcelo Sztainberg, Ph.D.

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Recommender systems are of great importance for delivering relevant content to application and website users. As users provide feedback either explicitly or implicitly, they receive better and better targeted recommendations for items such as movies, books, ads, or restaurants. In this research, we compare multiple collaborative filtering recommender system algorithms using 5-fold cross validation on the MovieLens dataset, which consists of 943 users, 1,682 movies, and about 100,000 ratings, and build an application with a graphical user interface (GUI) where users can review movies, thus adding to our dataset and influencing recommendations. We built two different types of recommender systems using Python: neighborhood-based models, of which we constructed versions based on item similarity and user similarity, and a Weighted Non-negative Matrix Factorization (WNMF) model. Our preliminary results regarding accuracy of the neighborhood-based models include a mean absolute error (MAE) of 0.8123 “stars” on a 1--5 star rating scale for the item similarity model, and an MAE of 0.8066 “stars” for the user similarity model. The WNMF model yields more accurate results, with a MAE of

0.7456 “stars”, while also being the most computationally efficient of the models tested. Lastly, we designed and built a GUI interface for the WNMF recommender system that allows users to receive a list of top-5 movie recommendations upon providing ratings for five or more movies listed in the MovieLens dataset.

## **5. A COMPARATIVE STUDY OF LACTOFERRIN AND LYSOZYME IN PRETERM AND FULL TERM HUMAN MILK**

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Breast milk is a source of nutrition as well as protection for infants. The immune system of human infants is not well developed at birth and breast milk protects the infant from infections such as necrotizing enterocolitis. Therefore, as the immune system of the infant develops, the amount of lactoferrin and lysozyme would be expected to decrease. We determined the level of lactoferrin in term milk using Western blot. Some of the antibacterial effects of milk are due to two proteins, lactoferrin and lysozyme, found in large quantities in breast milk. Lactoferrin is an iron-binding protein, important for protection against infection and inflammation. Bacteria require iron for growth and lactoferrin inhibits growth by chelating iron. Lysozyme, an antimicrobial enzyme, hydrolyzes 4-beta-linkages in the peptidoglycan layer of Gram-positive bacterial cell wall thus killing the bacteria. The content of lactoferrin and lysozyme in breast milk is believed to change according to the needs of the infant. Milk was obtained from Mothers' Milk Bank of Western Great Lakes. The activity of lysozyme using turbidimetric assay with *M. luteus* culture. However, we did not observe appreciable activity of lysozyme using this method, in spite of varying bacterial content, pH and temperature. We will test a more sensitive colorimetric assay next. The results of this study will help determine the antimicrobial activity of milk at different stages of lactation.

## **6. HYDRAULIC SYSTEM CONSTRUCTION FOR DARK MATTER CHAMBER DETECTOR AT NEIU**

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There is compelling astronomical and cosmological evidence that ~85% of the matter in the universe is dark matter: weakly interacting particles that are expected to rarely scatter off nuclei in the laboratory with enough energy to be detectable with a device of sufficient sensitivity. Detection of dark matter is the goal of the PICO collaboration, which employs bubble chamber technology for this purpose, and my research involves contributing to the design and construction of a bubble chamber at NEIU. Bubble chambers contain a superheated fluid that is so sensitive that a single particle interaction can cause it to boil. The first indication of boiling is a bubble and once a bubble is detected the chamber must be reset by rapidly raising the pressure to stop the boiling process. My research involves designing and building the hydraulic system that is able to raise and lower the pressure in a bubble chamber between atmospheric pressure and 200 psi. The system uses a pump, two hydraulic accumulators and a series of valves to control the pressure in the bubble chamber. One of the accumulators is

maintained at a high pressure by a pump, while the other is maintained at a low pressure. When a bubble is detected a series of valves opens the high-pressure accumulator to raise the pressure in the bubble chamber. After the liquid has settled, the low-pressure accumulator is opened to lower the pressure and resume the detection process.

## **7. INTERNET SEARCHING BEHAVIORS OF LOW-LITERACY BREAST CANCER SURVIVORS: OBSERVATION AND ANALYSIS**

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Adequate health literacy is important for maintaining good health, managing disease and self-advocacy. Internet searching is a popular tool for patients to find health-related information, yet low-literacy Latina breast cancer survivors may be less likely to benefit from this resource. When using common web search engines to find health information, behaviors such as misspelling, misappropriation of words and incomplete search queries can result in inadequate results and misleading information. The purpose of this study is to understand the search strategies and common mistakes that low-literacy Latina breast cancer survivors exhibit when searching for information online. In this research, a focus group comprised of Latina breast cancer survivors and their caregivers were observed searching for information online. Participants were asked to type or speak queries to a search engine and to summarize their answers after finding satisfying results. The computer activity of each dyad (survivor-caregiver) was audio and video recorded. A coding scheme was developed by two trained researchers to extract features under categories such as web activity, search behavior, and content, in order to identify behavioral patterns among the participants. It was found that participants spent a considerable amount of time evaluating results and viewing website content before providing answers for a given query. In addition, notable behavior such as reading aloud was prevalent. Future work should include recruiting a larger sample of participants to validate consistency of these results and enable the programming of interfaces that can mediate between patients and search engines.

## **8. MONITORING AIR QUALITY IN AN URBAN AREA USING MOSS**

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According to the World Health Organization, air pollution is the cause of 3.3 million premature deaths worldwide per year. Much of this is from fossil fuel combustion for transport and power generation. Urban areas are particularly vulnerable due to the amount of emissions and close proximity to sources. Biomonitors, organisms that provide information on changes in an ecosystem, offer a cheap alternative to conventional air quality methods. Last year, using moss we saw an increase in sulfur levels in spots around the Chicagoland area that seemed to correlate with higher levels of diesel particulate matter. In this project, our goal was to we could replicate our results. We used the moss genera *brachythecium*. Moss samples were weighed and placed into nylon mesh bags

with Espoma Organic Peat Moss as a substrate and distributed to 28 museum staff for placement. They were recalled after a week and analysis of 32 elements was conducted using a Thermo Noran x-ray fluorescence machine. While we did see sulfur, it also appears that heavy metals such as lead, manganese, and chromium showed changes. These metals are considered by the EPA to pose the greatest risk to human health in urban areas. However, there does not appear to be a correlation between locations and changes in composition, with some sites having an increase and others having a decrease. These elements are also found in the substrate used and nylon. These results show that the exact source and significance of these changes has yet to be determined.

## **9. USER-CENTERED DESIGN OF A COMPUTATIONAL THINKING WEBSITE FOR EDUCATORS IN STEM**

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Computational thinking (CT) consists of problem-solving techniques used by computer scientists. However, CT has countless applications outside the discipline of computer science and is therefore being included in K-12 education. Over the past two years, as part of an NSF grant, an interdisciplinary team of faculty and students at NEIU have worked to incorporate CT and coding modules into courses in the university's program for pre-service elementary- and middle-school STEM teachers. In order to disseminate this work, we have developed a website for education professors and current and future teachers to use. Our team designed this website first using Marvel, a prototyping tool, and then as a responsive website using HTML, CSS, and Bootstrap. We scheduled several interviews with university professors and both current and future K-8 teachers to obtain feedback on their needs and the look, feel, and content of our website. In addition, we will evaluate the usability of the website using the System Usability Scale (SUS) on a class of pre-service K-8 STEM teachers. Our main goal is to develop a website that considers the needs of our target users by providing access to CT and coding modules in an easy-to-use way so that teachers can use our materials to incorporate CT and coding into their own classrooms.

## **10. CYTOTOXICITY AND CRYSTAL STRUCTURE OF ARSENOPLATIN-1-IODIDE COMPLEX**

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Arsenoplatins (AP) are a new class of anticancer compounds containing dual pharmacophore moieties from two inorganic, FDA approved anti-cancer drugs, cisplatin, [Pt(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>] and arsenic trioxide, As<sub>2</sub>O<sub>3</sub>. Each of these two drugs induces apoptotic cell death but through different mechanisms: cisplatin targets nuclear DNA, whereas As<sub>2</sub>O<sub>3</sub> targets zinc-finger proteins. Results of the NCI-60 (NCI: National Cancer Institute) human tumor cell line

screen have shown that the first arsenoplatin compound synthesized  $[\text{Pt}(\mu\text{-NHC}(\text{CH}_3)\text{O})_2\text{ClAs}(\text{OH})_2]$ , (AP-1), is more potent than  $\text{As}_2\text{O}_3$  or cisplatin in the majority of cell lines tested. Furthermore, studies indicating increased anticancer activity of a cisplatin-iodide analog inspired us to synthesize an AP-1-iodide complex  $[\text{Pt}(\mu\text{-NHC}(\text{CH}_3)\text{O})_2\text{IAs}(\text{OH})_2]$ , (AP-5). Structural characterization of AP-5 has been determined by X-ray crystallography, elemental analysis, and NMR. In this study, the anticancer efficacy of AP-5 is tested *in vitro* against the triple negative breast MDA-MB-231 cancer cell line, an aggressive cancer currently lacking an effective method of treatment. The results of *in vitro* cytotoxicity assays have shown that AP-5 is more cytotoxic than AP-1 or cisplatin, with  $\text{IC}_{50}$  values of AP-5, AP-1, and cisplatin of  $5.7 (\pm 1.0) \mu\text{M}$ ,  $9.5 (\pm 0.1) \mu\text{M}$ , and  $22.3 (\pm 2.8) \mu\text{M}$ , respectively. The effect of AP-1 and AP-5 on glutathione (GSH) level is investigated to understand the difference in the activity. Compared to AP-1, which increased the GSH level, AP-5 decreased the GSH level in the MDA-MB-231 cancer cells. The depletion of GSH sensitizes cancer cells to platinum drugs and could be a reason for the higher cytotoxicity of AP-5.

## 11. CYBERBULLYING CLASSIFICATION: ANALYSIS OF TEXT IN SOCIAL MEDIA MEMES

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The rise of online communication via social networks has facilitated an increase in cyberbullying incidents that can cause psychological distress to victims. In this research, we examine graphic text found in memes from social networking sites and build a machine-learning model that can adequately identify bullying in text images. Using optical character recognition (OCR) technology developed by Google, we extract text from memes in order to study their linguistic properties using a Bag of Words approach. Then by applying our trained supervised classification model, it is determined whether these texts contain bullying messages. Our model was trained on a corpus of data from the former Q&A networking site Formspring and of data that we gathered and labeled from Twitter. The performance of three main classifiers were tested and compared: Naïve Bayes, Random Forest, and Support Vector Machines. We found that with Naïve Bayes and the use of Synthetic Minority Over-sampling Technique (SMOTE), an 83% overall prediction accuracy was achieved when attempting to accurately predict whether the text contains cyberbullying. A tool that accepts a .jpg file and determines if it contains cyberbullying text was also created. Future goals for this research include improving the model's accuracy by further training it with additional existing Instagram and Twitter datasets, along with publishing our tool to a webpage where the general public can screen their own text images for bullying and simultaneously enhance the accuracy of our tool. The tool could also be implemented by social networking sites in order to combat cyberbullying.

## **12. NANOCRYSTALS IN MELT INCLUSIONS FROM NYAMURAGIRA VOLCANO: A WINDOW INTO DEGASSING PROCESSES**

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The way magma degasses within a volcanic system prior to eruption impacts the explosivity of the eruption. Pre-eruptive conditions of a volcano's magma chamber can be assessed through the study of melt inclusions (MIs), which are small globules of magma trapped inside growing crystals deep within a volcano. An ideal location for these studies is Nyamuragira Volcano (D.R. Congo, Africa), erupting roughly every 2 years and producing many crystals with potential MIs. We focused on the 1986 and 2006 eruptions as the latter was much more explosive than the former. Why was this the case? Although both samples appear to be naturally glassy under an optical microscope, data from a previous study suggest that the 1986 MIs actually contain nanocrystals, which could help explain differences between the eruptions; crystallization of MIs may be caused by pre-eruptive degassing within the magma chamber. The current study will employ focused ion beam (FIB) milling and transmission electron microscopy (TEM) analyses to determine whether nanocrystals are indeed present in the 1986 MIs. Olivines from both eruptions will be set in epoxy and polished until the MIs are exposed. Thin films will then be milled from the MIs with the FIB and analyzed by the TEM to evaluate the existence of nanocrystals. If nanocrystals exist in the 1986 MIs, this would suggest that pre-eruptive degassing caused post-entrapment water loss from these MIs as the magma stalled in the shallow crust, allowing depressurization of the chamber, where the 2006 magma did not, resulting in greater explosivity.

## **13. EDAPHIC INFLUENCE ON PLANT SPECIES COMMUNITY AND SPECIES DISTRIBUTION WITHIN A HIGH-QUALITY TALL-GRASS PRAIRIE IN MARKHAM, IL.**

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Gensburg-Markham Prairie (GMP) is a High-Quality Tall-Grass Prairie located in Markham, IL. GMP provides a wealth of ecosystem services and habitat for many insects, birds, mammals and plants. Previously GMP has been studied for conductivity, hydrology profiles, and in the summer of 2018 plant diversity. In 2018, 71 plants were recorded at 13 water-level-wells and now the focus is on to determine plant community distributions relationship to soil moisture and soil pH. Using a traditional method, plants were recorded at 26 points across GMP spanning three mapped soil types: Wasteka Loamy Fine Sand, Selma Loam, and Hoopeston Fine Sandy Loam. ARCGIS was used to construct a map displaying plant community distributions. It was expected that there would be a significant difference in plant species within three soil boundaries. Using two-tailed t-test with equal variances no significant difference was found between any of the three soil types and plant species or soil moisture. There was recorded significant difference between initial canopy height and final canopy height (cm), ( $\alpha < 0.05$ ), for late June compared to late July. Future research includes comparing vegetation from GMP to roof top Green Infrastructure vegetation and noting similarities or differences in plant growth relative to similar soil properties.

## **14. INVESTIGATING EFFECTS OF ALUMINUM(III) ION ON AMYLOID PEPTIDE AGGREGATION IN ALZHEIMER'S DISEASE**

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Alzheimer disease (AD) is a neurodegenerative disorder. Patients diagnosed with the disease have difficulty understanding, thinking, and creating new memories. Pathologically the disease is characterized by the presence of amyloid protein plaques and tangles of microtubule-stabilizing protein called tau in the brain. Amyloid proteins occur naturally, however in time with AD they are cleaved and become amyloid- $\beta$  peptides ( $A\beta$ ) which bind onto themselves to form toxic plaques. The increasing concentrations of metal ions with age in particular tissues has been observed in diseases including Alzheimer's disease (AD), and it has been established that metal ions facilitate the oxidative stress in the brain, which may elevate formation of  $A\beta$  plaques. In particular some studies have reported a higher concentration of aluminum in addition to other metals in those diagnosed with AD vs those without the disease. For better understanding the role of aluminum(iii) ion in the  $A\beta$  peptide aggregation as related to the pathology of Alzheimer's disease, we aim to develop a fluorescence assay based on the interaction between a fluorescent dye, thioflavin T, and  $A\beta$  peptides to detect and quantify  $A\beta$  aggregation at a variety of Al(iii) concentrations using a multiwell plate reader. We identified optimal emission and excitation wavelengths for the measurement of Thioflavin T fluorescence upon its association with  $A\beta$  aggregates as excitation at 485nm and emission at 528nm. An established protocol has been applied to observe the time-dependent  $A\beta$  peptide aggregation and its inhibition by Morin. We will next utilize this method to study  $A\beta$  peptide aggregate formation at the presence of Al(iii) and Al-chelating agents in details.

## **15. DEVELOPING A MODEL TO SCREEN FOR SMALL MOLECULE TREATMENTS THAT REDUCE ADVANCED GLYCATION END PRODUCTS USING *C.ELEGANS***

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Prostate cancer is the second leading cause of cancer death among men in the United States. Recent studies have found that advanced glycation end products (AGEs) are elevated in the serum of African American compared to European American men. AGE metabolites are harmful and naturally form when glucose covalently attaches to proteins, lipids or nucleic acids in a non-enzymatic reaction. Failure by protective cellular pathways leads to AGE accumulation and this accumulation may serve as a potential biomarker for aggressive forms of Prostate Cancer. Since *Caenorhabditis elegans* shares conserved components of AGE detoxification pathways, we are developing a high throughput screen to identify small molecules that reduce AGE accumulation in the nematode. To induce rapid accumulation of AGEs, we fed animals a 2% glucose diet and added exogenous methylglyoxal (7mM), a precursor to AGE formation. AGE accumulation was monitored using a green fluorescent protein (GFP) reporter, where an increase in fluorescence reflected an increase in the level of AGEs. To enhance AGE accumulation, we generated *C. elegans* strains that carry a mutated version of the AGE detoxification enzyme GLO1, which removes glucose, adducts. We will feed these mutated strains a 2% glucose diet and treating them with a high

concentration of methylglyoxal (7mM), which should lead to AGE accumulation and therefore higher fluorescence. This increase in fluorescence will allow for high throughput assays to test for drug candidates that reduce AGEs. Targeting this pathway may represent a step in our understanding of underlying cellular mechanisms that contribute to prostate cancer disparities.

## **16. CYTOPLASMIC AGGREGATES OF HUMAN TDP-25 PROTEIN IN *C. ELEGANS* CHALLENGE PROTEOSTASIS**

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Proteostasis, the process by which a cell maintains protein production, folding, and degradation is critical for survival; however, the fidelity of this process declines with age. Disturbance of proteostasis contributes to many age-related neurodegenerative diseases, such as Amyotrophic Lateral Sclerosis (ALS), leading to the accumulation of misfolded proteins. Patients with this disease accumulate an aggregated form of the ALS associated protein TDP-43 in neurons, suggesting a disruption in proteostasis. Here, we are using the nematode *C. elegans* to examine how a toxic fragment of TDP-43, called TDP-25, challenges proteostasis. *C. elegans* is our model of choice because of its short life cycle, its transparent nature, and conservation of genes with human homologues. We have generated multiple transgenic lines expressing fluorescently tagged TDP-25 in the body wall muscles of the animal. Using gel electrophoresis followed by Western Blot Analysis, I will evaluate the steady state level of TDP-25 in each of the three transgenic lines during development and aging. Furthermore, the aggregation state of TDP-25 will be monitored with an expectation that the aggregation level increases with age. The strain with the highest steady state level will be identified and then aggregation will be examined. We anticipate a high level of TDP-25 will lead to an increase in aggregation in aging animals by challenging proteostasis.

## **17. SYNTHESIS, CHARACTERIZATION, AND ANTICANCER ACTIVITY OF ARSENOPLATIN-4**

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The FDA approved inorganic anticancer drug, arsenic trioxide (As<sub>2</sub>O<sub>3</sub>), is highly efficient for treatment of acute promyelocytic leukemia, but due to its rapid renal clearance in the form of arsenous acid, As(OH)<sub>3</sub>, it has been ineffective in the treatment of solid cancers. A new class of potent anticancer agents, that contain As(OH)<sub>2</sub> moiety



bound to platinum(II) center, arsenoplatins  $[\text{Pt}(\mu\text{-NHC(R)O})_2\text{XAs(OH)}_2]$  ( $\text{R}=\text{CH}_3$  or  $\text{CH}_3\text{CH}_2$ ),  $\text{X} = \text{Cl}^-$ ,  $\text{SCN}^-$ ) have been synthesized. A high Pearson correlation coefficient ( $r = 0.96$ ) was obtained while comparing anticancer activity of arsenoplatin-2 ( $\text{R} = \text{CH}_3\text{CH}_2$ ,  $\text{X}=\text{Cl}^-$ ) to  $\text{As}_2\text{O}_3$  in the NCI-60 screen, suggesting the two compounds act in a similar manner. This project aims to synthesize, characterize, and test the anticancer activity of an iodide analog, labeled AP-4. X-ray, NMR, and elemental analysis have been completed to determine the structure and purity of this new compound. The cytotoxicity of AP-4 in the triple negative breast MDA-MB-231 cancer cell line has been evaluated by MTS cell proliferation assay. The results of the cytotoxicity assays have shown that AP-4 is two times more cytotoxic than AP-2. Interaction of AP-4 with the biologically important molecule glutathione (GSH) was assessed by fluorescent detection assay. GSH depletion has been shown to sensitize cancer cells that are resistant to platinum drugs. The effect of AP-4 concentrations on the GSH level is discussed. Based on current results, AP-2 and AP-4 may act as a delivery vehicle for  $\text{As}_2\text{O}_3$ , overcoming one of the primary limitations of  $\text{As}_2\text{O}_3$  as a drug for solid cancers.

## 18. SPEECH GESTURE MISMATCH IN FRACTION UNDERSTANDING MAY REFLECT KNOWLEDGE IN TRANSITION

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Previous studies on mathematical learning have looked at how conceptual understanding can be conveyed differently between verbal and nonverbal expression (a speech-gesture mismatch). Production of *nonverbal correct* ideas that children produce along with *verbal incorrect* ideas has been shown to index transitional understanding and *readiness to learn*. However, this has not been explored in fraction learning. This present research attempted to identify this pattern with children who are learning about fraction magnitudes. We hypothesized that some children convey correct understanding, *but only through nonverbal expression*, and that this nonverbal expression does not indicate fully advanced comprehension. Video-recorded interviews were conducted with children ages 7-10 to assess their understanding of fractions. While verbalizing, they spontaneously used gesture to express fraction ideas. We examined whether correct fraction understanding *was only conveyed nonverbally* or *was conveyed both verbally and nonverbally*. We tested children's prior knowledge of fractions using a 10-item standardized test. 18 chi-square analysis were conducted, level of fraction understanding of participants (Low and High) vs. different types of manipulatives participants used to explain their fraction understanding (Number line, etc.). When using both fraction circles and fraction bars to explain  $\frac{1}{4}$  and  $\frac{7}{5}$  respectively, the low group incorrectly matched more often while the high group mismatched and correctly matched more often ( $r = 2.09(2)$ ,  $p = .01$ ) ( $r = 2.09(2)$ ,  $p = .01$ ). Results suggest that children with high knowledge of fractions express this understanding in many ways and that children that mismatch are in a state of transition towards higher knowledge.

## 19. EFFECTS OF POTENTIAL INTERACTORS OF MITOCHONDRIAL FISSION PROTEIN FIS1 ON MITOCHONDRIAL DYNAMICS IN THE HUMAN PARASITE *TOXOPLASMA GONDII*

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*Toxoplasma gondii* is a parasite that can infect any warm-blooded animal, through means such as undercooked meat, contact with cat feces, or via congenital transmission. Upon infection, *T. gondii* causes toxoplasmosis, which is often asymptomatic in healthy adults, but can cause birth defects such as blindness and premature birth. *T. gondii* is a eukaryotic parasite with a single mitochondrion that is more plant-like, dynamic, and is a validated drug target. It has been observed that FIS1, a protein on the mitochondrial membrane, has a role in recruiting proteins for mitochondrial division in higher eukaryotes. We found that mislocalizing it disrupts the mitochondrial shape, indicating that it may interact with something new or is pulling away potential interactors from the mitochondria. We would like to study how Fis1 interactors are important for mitochondrial morphology. We found three potential FIS1 interactors by Yeast 2-Hybrid analysis that are predicted to be essential for parasite survival. TGGT1\_287980 was found to localize in the inner membrane complex, which interacts with the mitochondrion, TGGT1\_224270 is in the mitochondrion, and TGGT1\_293840 has no known function or localization, but is unique to *T. gondii*. We are using a rapamycin-inducible mRNA degradation system to conditionally knockdown proteins 224270 and 287980. We will observe how decreased expression of these proteins affects parasite survival and mitochondrial dynamics. By studying the effect of these proteins on the cell signaling pathways that regulate the lytic cycle of *T. gondii*, we can develop specific anti-parasitic drugs that target the events of invasion, egress, and division, which are essential for parasite survival.

## 20. THE ZEBRAFISH BLUES: HOW WELL CAN DEPRESSED ZEBRAFISH LEARN?

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The purpose of this study is to examine the relationship between depression and learning. The hypothesis is that treatment with a neurotoxin that is associated with mimicking depression (MPTP) reduces learning capacity in zebrafish. Twenty-four adult zebrafish were randomly selected and housed in groups of twelve. The fish were trained through classical conditioning to associate food with a provided blue light stimulus. For training, fish were captured, light and food stimuli were presented, and fish were released. An hour after training, testing was done. During testing, no food was presented, and light placement was randomized. Behavior was recorded and tracked with the program ImageJ. The first frame showing correct side preference was determined and total time spent on the light side was calculated for the control fish. Initially, 69.23% of fish swam to the correct side of the tank within one second. By the eighth trial, the number had increased to 87.23%. During testing, the fish spent 52.75% on the correct side of the tank ( $M = 9.89$  sec,  $SD = 4.74$ ). This procedure will be repeated after treatment with 100  $\mu$ M MPTP. After MPTP, training results are expected to show a decrease in the number of fish swimming to

the correct side and a decrease in place preference during testing. Preliminary results show that the fish did learn over the training period. With depression being a widespread affliction, research with zebrafish will increase our understanding of how neural circuits related to depression impact learning.

## **21. WAYS TO USE MOSS AS AN INDICATOR OF AIR QUALITY**

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In this study, we used moss in a variety of experimental setups to monitor urban air quality in various neighborhoods of Chicago. Prior research from our group and others has shown that moss may be an effective biological monitor for air pollutants. Previously we had used moss biobags strategically placed within a small region of the Chicago metro area to monitor for 45 different compounds, including magnesium oxide, aluminium oxide, silicon dioxide, phosphorus pentoxide, sulfur, chlorine, potassium oxide, calcium oxide, titanium, and iron. This study aims to expand our region of study, to verify previous data and methods, and to modify our experimental setup to optimize deployment conditions. We experimented with watering regimes (manual watering vs. no watering), moss type (*Brachythecium* vs. *Sphagnum*), and bag type (nylon vs. polyethylene). Bags were placed outside in the Chicagoland area and measured before and after two weeks with an X-ray fluorescence machine (XRF). XRF measurements indicated that manually watered moss absorbs less pollutants than moss that is not watered. *Brachythecium* appears to absorb more pollutants than *Sphagnum*, and mosses in polyethylene appears to absorb more pollutants than mosses in nylon. All measurements implicated that *Brachythecium* moss under the right conditions can be used as an efficient pollution absorber, and effective biological indicator.

## **22. ESTABLISHING MUTAGENIC EFFECTIVENESS IN CRISPR/CAS9-INJECTED ZEBRAFISH (*D. RERIO*) USING THE HETERODUPLEZ MOBILITY ASSAY(HMA)**

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Microinjection of Crispr/Cas9 into the single-cell zebrafish embryo is a powerful technique to edit the zebrafish genome. The Cas9 endonuclease creates targeted double strand break (DSB) specified by a custom guide RNA (gRNA). Errors in DSB are repaired but often result in genomic insertions and deletions (indels) that have the potential to disrupt the targeted gene. To determine the efficiency of our custom gRNA, we sought a method that would allow us to compare the relative numbers of wildtype to mutated cells that were microinjected zebrafish embryos. Here we employed a method called the heteroduplex mobility assay (HMA) to find indels at a particular target site, lamtor3. To identify indels, we genotyped Crispr/Cas9 injected zebrafish (Crispants) by obtaining a DNA sample from a tail clipping and using PCR to amplify the target site. By rapidly cooling the PCR products, we induced the annealing of mismatched PCR products to form “heteroduplexes”. We next used polyacrylamide gel electrophoresis (PAGE) to compare the relative level of heteroduplexes to homoduplexes in DNA extracted from wildtype and crispant tails. We determined that 40%-60% of the crispants show evidence of indels in our

lamtor3 crispants. Future directions are to optimize the method to confidently measure the ratio of hetero- to homo-duplexes and breed high-ratio crispants. This will allow us to continue to follow protocol where we can determine strategy to make high ratio of crispants. After getting high ratio of crispants we will use the protocol to determine if we can find high ratio of crispants in new target gene.

### **23. VALIDATION OF A HIGH-THROUGHPUT DRUG SCREEN ON A YAP-TFE3 DRIVEN ANCHORAGE-INDEPENDENT CELL GROWTH ASSAY**

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Identifying an anchorage-independent cell growth phenotype within NIH 3T3 cells expressing the t(X;11) chromosomal translocation of a *YAPI-TFE3* (YAP) genetic alteration and transcriptional coactivator gives insight into the oncogenic role of YAP in cancer, and the pathogenesis of malignant vascular sarcomas such as epithelium hemangioendothelioma (EHE). Regulation by the Hippo signaling pathway induces phosphorylation of YAP by a highly conserved serine/threonine kinase cascade composed of large tumor suppressors 1 and 2 (LATS1/2), which are anteriorly phosphorylated by mammalian STE20-like protein kinase 1 and 2 (MST1/2). A high-throughput drug screen of 1000 FDA-approved compounds was performed to isolate those compounds suppressing the phenotype. We hypothesized this screening would identify compounds that perturb the described functions of the Hippo signaling pathway. Utilizing an MTT-style assay, numbers of living cells, which are directly proportional to the amount of formazan dye generated by dehydrogenase activity, were detected via Gen5 software absorbance readings. Administration of .001, .01, .1, 1.0, and 10.0  $\mu$ M of drugs were added into Empty Vector (EV) cells and YAP-transfected cells in a 10-fold serial dilution. Four compounds were tested: Genistein, Teniposide, Mitoxantrone, and Trifluridine. Treatment with Genistein showed a decrease in anchorage-independent growth in cells expressing YAP at higher concentrations, but relatively little change in EV ( $p = 0.03$ ). Teniposide reduced anchorage-independent growth in YAP expressing cells to a greater than Genistein and mildly decreased absorbance in EV. Mitoxantrone mildly decreased absorbance in both YAP and EV, while Trifluridine did not significantly alter anchorage-independent growth in either YAP or EV cells.

## 24. HOW IMPORTANT IS EXPRESSING FRACTION UNDERSTANDING CONSISTENTLY ACROSS SPEECH, GESTURE, ACTION AND DRAWINGS?

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The United States is ranked 38<sup>th</sup> out of 71 countries in the mathematical portion of the PISA (Programme for International Student Assessment). Cognitive barriers in numerical development have prevented many from entering STEM fields, such as students from low SES and minorities. One math concept that is particularly difficult to master is fraction magnitude. Theory suggests that mathematical understanding is reflected in the ability to represent a concept across multiple expressive verbal and nonverbal modalities: *speech*, *gesture/action*, and *drawings*. Research suggests that the correct understanding of fractions is indicated by whether children understand that fractions are equal parts related to a whole. However, few have examined how children's understanding of fractions is manifested in multiple expressive representations. In this study, we examined 26 video-recorded interviews of children ages 7-10 years explaining their understanding of a particular fraction:  $1/4$ . Some children were then given the opportunity to express their understanding of fractions through a variety of verbal (speech) and nonverbal (gesture/action and drawings) modalities. Using a standard assessment, we classified children with either high- or low-fraction understanding. We found that children classified as having *high-fraction understanding* were able to express correct fraction ideas consistently across all three expressive modalities. Whereas children with low-fraction understanding failed to express correct ideas across modalities; expressing incorrect ideas in some while correct ideas in other modalities. This study provides support that in order to help children understand fractions, teachers need to find a way to enforce the integration of fraction concepts across multiple expressive representations.

## 25. ONE FISH, TWO FISH, THREE FISH, FOUR: THE EFFECT OF GROUP SIZE ON THE PERSISTENCE OF ZEBRAFISH

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Stressful conditions such as social isolation affect behavior in many organisms. The current study examined the impact of group size on persistence on zebrafish. Persistence in our study was defined as the number of seconds a fish spends at the food stimulus. More time spent at the food stimulus will indicate higher persistence. zebrafish who were alone would demonstrate less persistence than those in pairs. Adult male and female zebrafish were randomly selected from home tanks and placed into an 8x8in tank. Fifteen fish were tested; 10 were tested in groups of 2 (CON2), and 5 were tested individually (CON1). The fish were acclimated in the testing tank for one minute and were captured in a clear cylinder before placing a small piece of food on a plexiglass strip onto one wall of the testing tank. The plexiglass was used to keep a controlled food stimulus present throughout the experiment. ImageJ was used to record the fish for one minute and determine the location of the fish relative to the piece of food in the tank. Preliminary results show that CON1 had a higher persistence than CON2 ( $M_{CON1} =$

8.14 sec,  $SD = 7.99$  ( $n=5$ );  $M_{CON2} = 5.20$  sec,  $SD = 3.32$  ( $n=10$ ). When comparing the two zebrafish in the CON2 condition, no notable differences were seen between the two fish tested together. ( $F1_{CON2}=5.60$  sec,  $SD=3.62$  ( $n=5$ );  $F2_{CON2}=4.81$  sec,  $SD_C=3.02$  ( $n=5$ )). Similar to other species, group size impacts behavior. CON1 has a higher persistence, which demonstrated how individuals may become more persistent with a certain task when faced with it alone. Future studies should examine an increase in group size and the impact of possible success to better understand the influence of environmental and psychological factors on persistence.

## **26. A GENETIC SCREEN TO IDENTIFY NEW FGFR SIGNALING COMPONENTS IN *C. ELEGANS***

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Fibroblast growth factor receptors (FGFRs) are cell-surface receptor tyrosine-kinases (RTKs) that phosphorylate specific intracellular tyrosine residues to trigger downstream responses such as cell proliferation, migration, and differentiation. The study of the EGL-15 FGFR in the nematode *C. elegans* has long been used to understand principles of RTK signaling, since defects in the processes mediated by EGL-15 result in striking phenotypes that provide powerful genetic tools. One such process is the regulation of fluid homeostasis. Hyperactivation of EGL-15 causes excessive accumulation of clear fluid inside the worm's body cavity (the Clr phenotype). The isolation of Suppressor Of Clr (*soc*) mutants has led to the identification of many of the core components of EGL-15 signaling, such as the Grb2/SEM-5 adaptor protein that links RTK signaling to the RAS/MAPK pathway. Although SEM-5 is required for EGL-15 signaling, the *egl-15(n1457)* mutation, that truncates the carboxy-terminal domain of EGL-15 ( $\Delta$ CTD) and eliminates its known SEM-5 binding sites, does not confer a Soc phenotype. These data suggest the existence of an alternate pathway that links EGL-15 to SEM-5/Grb2. To identify components of this alternate pathway, we repeated the screen for Soc mutants in an *n1457* ( $\Delta$ CTD) background. Interestingly, many of the enhancer mutations show only partial Soc phenotypes on their own, and are enhanced by the *n1457* ( $\Delta$ CTD) mutation. Preliminary characterization of these enhancer alleles indicates that they define up to three new *soc* genes. Genetic analysis and whole-genome sequencing will be used to determine the molecular identities of these potential new FGFR signaling genes.

## 27. INTEGRATING COMPUTATIONAL THINKING INTO THE CLASSROOM

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Our research is to analyze students' self-efficacy in computational thinking practices. At a time when technology is changing, teachers need to stay current to help their students acquire basic computer skills. To teach these skills, teachers must also understand them. Specifically, we want to prepare pre-service teachers to use computational thinking in their future classrooms. This should make computer science and STEM concepts more accessible and prepare teachers that are competent in using computational thinking and are able to develop those skills in their students. This is done by the implementation of teaching modules in Geometry and Physics courses for pre-service teachers. The final Geometry project is art-based: the pre-service teachers will choose a piece of art that speaks to them and build code in Scratch to produce something of their own interpretation. The Physics project involves student-selected maps to personalize their lessons. To analyze the impact of the modules on pre-service teachers we surveyed them before and after the completion of the modules. These surveys measure their self-efficacy in understanding computational thinking concepts and the utilization of them. The students expressed improvement to many of the questions, specifically in their abilities to "break a complex problem into smaller, more manageable parts", "manipulate variables or components", and "modify code to complete small tasks." Furthermore, we saw increased improvement when students took both courses.

## 28. MODELING NEUROFIBROMATOSIS TYPE 2 IN ZEBRAFISH (*DANIO RERIO*)

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Neurofibromatosis Type 2 (NF2) is a hereditary human disease that causes the growth of bilateral benign tumors on the auditory-vestibular nerve (cranial nerve VIII). The disease is caused by mutations in the *Neurofibrinomin 2 (NF2)* gene, which encodes the cytoskeletal protein, Merlin. Merlin normally acts as a tumor suppressor. The zebrafish (*Danio rerio*) genome encodes two homologues of the NF2 gene, named *nf2a* and *nf2b*. The genes *nf2a* and *nf2b* retain 78.59% and 71.10% homology to human NF2, respectively. To study the function of these genes in zebrafish, we generated two knockout strains with targeted mutations. For this study, we injected single-celled zebrafish embryos with Cas9 nuclease and a single-guide RNA targeting either the first exon of *nf2a* and/or the fourth exon of *nf2b*. We verified the presence of insertions and/or deletions (indels) in the gene using a heteroduplex mobility assay on a subset of 6-8 embryos per group of injected embryos. Groups with indels in greater than 60% of the analyzed embryos were raised to adulthood for further genetic analysis, tail fin genotyping, and breeding. We hypothesize that zebrafish missing one or both Merlin/NF2 homologues will

develop schwann cell-derived tumors (schwannomas) in the cranial nerves, mirroring those present in patients with Neurofibromatosis type 2. These fish will be useful as a model of Neurofibromatosis Type 2 and help us better understand the function of the Merlin protein and its role as a tumor suppressor.

## **29. EFFECTS OF PHOTOPOLLUTION ON MAMMALIAN GLUCOCORTICOID PRODUCTION**

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Many aspects of an organism's behavior and physiology are modulated by circadian clocks with periods of approximately 24 hours. These endogenous molecular oscillators are present in all mammalian cells and are synchronized with the external environment. Exposure to artificial nighttime light, known as photopollution, can disrupt the normal function of our circadian clocks which can lead to health problems such as difficulty sleeping, depression, and obesity. Cortisol, one of the main glucocorticoids, is produced with a circadian pattern. This hormone is important in regulating stress response, homeostasis, and proper health. We hypothesize that increasing levels of nighttime light will alter cortisol production. To test this hypothesis, we will use a Adrenocorticotrophic hormone (ACTH) challenge to examine the effects of photopollution on cortisol production in a mammalian model system (*Mus musculus*). We will perform the ACTH challenge on animals under increasing amounts of nighttime light (0, 6, and 30 lux) and will compare levels of fecal cortisol metabolites. Each fecal collection will be taken multiple times per day for 3 days before and after the ACTH injection. Preliminary data suggests that nighttime light increases the levels of fecal cortisol metabolites. Chicago is considered one of the most photopolluted cities in the world. Photopollution disrupts nocturnal ecosystems and it has adverse health effects that are not well understood. This research will improve our understanding of the relationship between photopollution and stress and the impact of photopollution on the health of urban mammals, including humans.

## **30. ASSESSING CPT1A REGULATION AT THE TRANSCRIPTIONAL AND TRANSLATIONAL LEVEL**

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Hormone-dependent prostate cancers preferentially use fatty acid oxidation (FAO) as their primary source of energy. Carnitine palmitoyltransferase 1A (CPT1A), an enzyme overexpressed by these cancers, shuttles long-chain fatty acids into the mitochondria and controls the rate-limiting step of FAO. Inhibiting CPT1A is known to delay tumor growth, and upregulating the androgen receptor (AR) increases CPT1A activity, but the role of CPT1A in hormone-based cancers is still poorly understood. There are no definitive studies showing how concentrations of androgens such as dihydrotestosterone (DHT) change the CPT1A mRNA and protein activity in metastatic prostate cancer cells. This project focused on determining whether the CPT1A pathway between the nucleus and mitochondria is regulated at the transcriptional or translational level or both, using real-time PCR



and western blot protein analysis in five prostate cancer cell lines as time and DHT concentration varied. We expected that as DHT levels rose, CPT1A expression levels would also rise, promoting FAO. This was true up to a point. However, in both the RT-PCR and western blot results, at higher levels of DHT concentration, CPT1A expression decreases. This suggests that there is an inhibitory androgen feedback mechanism at certain concentrations, as well as a stimulatory mechanism at low doses. The unexpected changes in CPT1A expression as time and DHT concentration varied suggests that the AR – CPT1A relationship pathway is likely indirect, and more complex than previously thought. Data from the androgen non-responsive PC3 cells suggests that the CPT1A downregulation may be operating independently of the classic androgen signaling pathways.

### **31. DESIGNING A POINT-OF-INTEREST RECOMMENDER SYSTEM USING MATRIX FACTORIZATION TECHNIQUES**

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Location based social networks (LBSNs) have become an essential part of life for smartphone users. Applications that are based on LBSNs include navigation, search/advertising, infotainment, tracking, etc. The sheer volume of new information in LBSNs produced every day can overwhelm people when they need to decide which places to visit, e.g., restaurants, supermarkets, bars. To avoid these confusions, Point-of-Interest (POI) recommender systems were proposed to help people find their favorite places based on LBSNs. In this research, we study several collaborative filtering techniques that are used in recommender systems and build a graphical user interface (GUI) based application that can interactively learn and predict user preferences. The techniques we study include item similarity model, user similarity model and weighted nonnegative matrix factorization (WNMF) model. We tested the first two similarity models using 5-fold cross validation on a Yelp data set that contains 11,900 users, 1,573 businesses and 33,880 reviews. The experimental results show that the prediction accuracy for the item similarity model measured by mean absolute error (MAE) is 1.0645 while this error is 1.2069 for the user similarity model. For WNMF, we tested iterations from 1 to 30 for latent factors roughly from 1 to 50. The 50 latent factor and 10 iteration gives the best result. Our goal is to build a prototype of a GUI based application that lets users rate business entities on a Google map and makes point-of-interest recommendations on the map in an effective and efficient manner.

### **32. THE INFLUENCE OF PARENT HOUSEHOLD, PARENT EDUCATION AND GESTURE INSTRUCTION ON CHILDREN'S MATH LEARNING**

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Research shows that gesture done while teaching can affect math learning. However, sociocultural factors have also been shown to impact learning: (1) children with one versus two parent households and (2) children with parents who lack a college education, can be challenged in math learning. The current study examines how gesture

may impact children with fewer social resources. We examined the role of instruction with gesture when certain parental factors varied (i.e., parents' education and whether children were from a single or two parent household) for children's learning of mathematical equivalence (understanding the meaning of the equal sign in problems like  $3+4+5=\_\_+5$ ). We examined Chicago area second grade classrooms (children ages 7-9) , using a pretest-instruction-posttest design. Children were randomly assigned to either *verbal instruction only* math instruction or *verbal instruction that included gestures* that convey imagery about the equal sign (e.g., depicting the balance between the two sides of an equation). Parent(s) were surveyed on their level of education and the parent household. Learning was operationalized as an increase in correct math solutions from the pre-to posttest. We hypothesized that children of single parents and parents with no college education would benefit least from math instruction. We also hypothesized that children exposed to *verbal instruction with gesture* would benefit significantly more than children exposed to verbal instruction without gesture. Analyses showed that gestured instruction benefitted children who have single parents and parents with no college education significantly more than children with two parents who both went to college.

### **33. RESPONSE OF DROSOPHILA MELANOGASTER DEFICIENT IN WERNER PROTEIN TO OXIDATIVE STRESS**

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Physiological stress and toxins generate highly reactive radicals which cause oxidative damage to DNA. DNA exonucleases, such as Werner exonuclease, remove damaged regions during DNA repair. When Werner gene is mutated in humans, it causes Werner syndrome, a disease characterized by advanced aging and cancer. In *Drosophila melanogaster*, *WRNexo* deficient (*WRNexo*<sup>Δ</sup>) mutants express high tumor growth and altered activity, and therefore, model Werner syndrome. To investigate *WRNexo*'s involvement in oxidative damage repair, we measured *WRNexo*<sup>Δ</sup> mutants' responses to different oxidative stressors. To investigate physiologically induced oxidative stress responses of *WRNexo*<sup>Δ</sup> adult mutants, we monitored activities in a *Drosophila* Activity Monitor (DAM) while exposing them to high temperature (29°C) or starvation. There was no difference between mutant and wild type (WT) activity levels in high temperature. Surprisingly, *WRNexo*<sup>Δ</sup> flies' activities increased during starvation compared to WT. Therefore, *WRNexo* does not appear to play a role in adult physiological oxidative repair. To determine if *WRNexo*<sup>Δ</sup> larvae are sensitive to oxidizing agents, we added KBrO<sub>3</sub> to larval food and analyzed the genotypic ratios of surviving adults; *WRNexo*<sup>Δ</sup> mutants display sensitivity to KBrO<sub>3</sub>, with 40.9% relative survival of *WRNexo*<sup>Δ</sup> mutants. Oxidative stress also causes low body fat by lipid peroxidation. Relative larval body fat was determined by buoyancy; *WRNexo*<sup>Δ</sup> larvae have lower body fat than WT. KBrO<sub>3</sub> larval sensitivity and low body fat larvae suggest *WRNexo* is involved in developmental oxidative damage repair. Studying the oxidative stress response of *WRNexo*<sup>Δ</sup> mutants, we hope to learn more about the Werner gene and its mechanism in cancer.

### **34. DETERMINATION OF IMMUNOGLOBULIN A AND ANTIBACTERIAL ACTIVITY IN HUMAN BREAST MILK**

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Breast milk is the sole natural source of nutrition and defense for an infant. It contains antimicrobial proteins and immunoglobulin A (sIgA) that help prevent infections. We studied sIgA content and bactericidal activity of human milk. Previous studies have shown that the sIgA content of milk varies pre- and postnatally, corresponding to the immunologic need of the infant. Breast milk was obtained from the Mothers Milk Bank of Western Great Lakes facility. We established a spectrophotometric assay for sIgA measurement using an enzyme-linked immunosorbent assay (ELISA). Our initial results show a detectable amount of sIgA in term milk. We will further compare these levels to those present in preterm and post term milk. Antimicrobial properties of milk were determined with *M. luteus* bacteria using a zone of inhibition test. Term milk showed a clear zone of inhibition of bacterial growth within 6 hours of incubation. The inhibitory effect increased with increasing concentration. We are also determining whether lysozyme plays a role in the antibacterial effect. Our study will help determine the role of sIgA and antibacterial proteins in milk. This study is especially important for preterm infants, who are susceptible to necrotizing enterocolitis, a disease that is often fatal. Studies show that breastfed preterm infants have lower rates of fatality as compared to formula fed ones.

### **35. THE EFFECTS OF METHYL-PHENYL-TETRAHYDROPYRIDINE ON PERSISTENCE**

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Depression often leads to fluctuations in motivational behaviors that reflect changes in dopamine levels. The purpose of this study is to determine the effect of MPTP (dopaminergic neurotoxin) on persistence in zebrafish. The hypothesis was that zebrafish that have been exposed to MPTP, both individually and in pairs will have a decrease in persistence. Adult zebrafish were randomly selected and placed into either the control or treated group. The treated group was dosed with a 100  $\mu$ M of MPTP for two minutes, three days prior to testing. Persistence was measured by the amount of time fish spent by the stimulus in an 8 x 8 in tank individually or in pairs. Behavior was recorded for one minute and videos were processed in ImageJ. Location of each fish relative to food placement was determined in each video. Preliminary results show that when tested in pairs, the treated fish had higher levels of persistence ( $M = 1.55$  sec,  $SD = 2.23$ ) than the control ( $M = 1.03$  sec,  $SD = 1.09$ ). When tested individually, the opposite is seen with treated fish showing a lower level of persistence ( $M = 1.05$  sec,  $SD = 1.58$ ) than the control ( $M = 1.55$  sec,  $SD = 2.23$ ). Similar to humans, changes in dopamine signaling alter motivational behavior. There was a decrease in persistence that was only seen when fish were tested individually. The lack of decrease in persistence when tested in groups suggests that social support can mitigate the impact of depression.

### **36. THE IMPACT OF SEASONALITY AND SOCIAL JETLAG ON ACADEMIC PERFORMANCE**

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Human circadian rhythms are 24-hour oscillations in an individual's behavior and physiology that are synchronized by light signals over the 24-hour day. These individuals develop stable phase relationships between the environment and their internal rhythms giving rise to different chronotypes (morning larks, afternoon finches, and night owls). The imposition of one's social schedule, termed social jetlag (SJL), can cause a misalignment between these rhythms and the environment. Such misalignments have been shown to have severe consequences to behavior and physiology. Previous studies have shown that increased overall SJL strongly correlates with decreased academic performance specifically in owls; however, changes in individual SJL have not been evaluated. Online records of daily logins from the Northeastern Illinois University learning management system Desire2Learn were used to study the interactions between circadian rhythms, SJL, and academic performance. We hypothesize that subtle changes in individual's SJL across the semester will have significant impacts on the student's academic performance. Data from over 3 million login events were analyzed in the R statistical package to identify patterns of SJL across individual students. Changes in SJL were evaluated by applying a linear model to each student and extracting the slope, x-intercept, y-intercept, and  $r^2$  values for analysis. Preliminary results suggest that academic performance can be altered by particular patterns in individual student activity. Some of these patterns minimize chronotype differences that have been shown previously. These data will provide knowledge for students, educators, and universities to optimize schedules, minimize SJL, and maximize overall academic performance.

### **37. DOES FRACTION UNDERSTANDING INVOLVE CONSISTENCY ACROSS MULTIPLE VISUAL MODELS?**

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In the United States, many children struggle with the mathematical concept of fractions. Previous literature shows that conceptual understanding of fractions is critical to obtain flexibility in mathematics and to achieve higher academic success. Previous theories about the development of mathematical understanding suggest that complex understanding of fractions requires explicit linking of multiple representations (including symbols and concrete models). The goal of this research was to identify and describe children's understanding of fractions through use of different representations (e.g., fraction circles, number lines, drawings) obtained through a structured, open-ended interview. In the interview, 21 second to fourth grade children were asked to show and explain the meaning of certain fractions (e.g.,  $\frac{1}{4}$ ). In addition, children individually completed a 14-item diagnostic worksheet and, based on this assessment, were categorized as having low- or high-fraction understanding. The types of concrete manipulatives children relied on during the interview were examined. Results showed that high-fraction knowledge was associated with expressing correct fraction understanding *consistently* across multiple

manipulatives whereas low-fraction knowledge was associated with expressing both correct and incorrect understanding *inconsistently* across manipulatives. These results suggest the need to develop instruction that facilitates linkages across multiple models to support children's development of flexible linking in mathematics.

## ABOUT THE STUDENT CENTER FOR SCIENCE ENGAGEMENT (SCSE)

The Student Center for Science Engagement (SCSE) is a resource to help students succeed at NEIU and in their future careers in the sciences. We serve all students interested in the sciences, and we support the following departments and programs: Biology, Chemistry, Physics, Earth Science, Environmental Science, Computer Science, Mathematics, and Psychology.

### We offer:

- **One-on-One Professional Advising** – Life science and physical science advisors assist students in exploring majors, internships, graduate school, and other career options. Advisors assist students in advancing their professional training by securing resources that support academic and professional goals.
- **Signature Workshops**-Workshops cover a broad range of topics including study skills, time management, graduate school, branding and networking, career planning and professional development planning. The Center emphasizes building strong professional development skills.
- **Tutoring and GRE Preparation**-The Center provides daily tutoring services in upper-level Biology, Chemistry, Computer Science, Earth Science, Genetics, Mathematics, and Physics courses. Free GRE classes are offered annually in June.
- **Research Opportunities** – Students are encouraged to gain valuable hands-on experience by helping through summer research opportunities with NEIU faculty and at other institutions.
- **Conference Attendance and Participation**-The SCSE supports students to attend and present their research at conferences locally and nationwide.
- **Invited Speakers**-The SCSE invites individuals representing organizations and industry to inform students on internships and career opportunities in a broad range of fields.







## 11th Annual Student Center for Science Engagement Research Symposium

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